Digital Photography Enhances Diagnostics, Communication, and Documentation

+ Edward A. McLaren | DDS, MDC
+ Todd Schoenbaum | DDS

Digital photographic equipment has evolved at a blistering pace. Most of the recent developments significant to dentistry involve the improvement in image management, ease of use and fine-tuning, integrated high-definition (HD) video, and incremental improvements in techniques. Good dental photography is primarily the result of practice, technique, and dedication. High-quality equipment is helpful, but is generally not the limiting factor.

The authors believe that digital single-lens reflex (SLR) cameras (Figure 1) versus consumer point-and-shoot type cameras offer the most consistent control, least image distortion, and, ultimately, highest image quality, and are, therefore, the best-suited camera type for dental use. Thus, this article will focus primarily on SLR cameras and related components. It should be noted, however, that point-and-shoot cameras do have a few niche applications within dentistry (eg, operating microscopes, oral cancer detection devices), and they also generally require a shorter learning curve, are somewhat less expensive than SLR systems, and are adequate for taking basic images. However, for the reasons stated above the authors use and recommend digital SLRs.

CAMERA SELECTION

While dozens of SLR cameras are available on the market, only a handful are well suited to dental photography. SLRs best suited for dental photography should have the following features: true macro lens available with a focal length of approximately 100 mm; dual-point and ring macro flashes available; customizable white balance; RAW capability; and an APS-C ("crop")-sized sensor (full-frame sensor cameras will also suffice). SLR cameras vary significantly in features and cost, though not significantly in potential image quality. More expensive units generally allow greater flexibility, easier and deeper adjustment, and are more robust.

Most modern cameras have resolution far beyond what is required for dental photography unless the user plans to print images beyond 11-in. x 14-in. It is generally accepted in the photographic industry that the necessary resolution for a quality printed digital image requires approximately 300 dpi (dots per inch). Thus, for an 11-in. x 14-in. image, this translates to a minimum camera resolution of approximately 14 MP (megapixels). One of the best reasons for having a higher resolution camera is the

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Fig 1. Digital SLR cameras are adaptable, accurate, and well suited to the demands of dental photography.
Fig 2. Dual-point flash systems provide exceptional fidelity, particularly when attempting to capture internal and external characteristics of teeth in the esthetic zone. Shown is Nikon's R1C1 system.
Fig 3. Ring flash systems are easy to use and well suited to surgical images and images using a mirror. However, the close proximity of the flash to the lens makes visualizing line angles, translucency, and surface texture difficult in the esthetic zone.
Fig 4. The "3:2 flash position" provides consistent results for shade matching images. Achieving this position requires an adjustable flash bracket (the bracket shown is from PhotoMed International, www.photomed.net).
Fig 5. Nikon SB-200 flashes with a piece of polarizing film taped in from of the flash.

▼ ABOUT THE AUTHORS

Edward A. McLaren, DDS, MDC

Founder and Director, UCLA Post Graduate Esthetics, Director, UCLA Center for Esthetic Dentistry, Founder and Director, UCLA Master Dental Ceramist Program, UCLA School of Dentistry
Los Angeles, California

Private Practice, Prosthodontics and Esthetic Dentistry
Los Angeles, California

Todd Schoenbaum, DDS

Assistant Clinical Professor, Assistant Director, UCLA Continuing Education, Assistant Director, UCLA Center for Esthetic Dentistry, UCLA School of Dentistry
Los Angeles, California

ability to enlarge an image and crop it. At higher resolutions there will then still be adequate detail in the image.

The authors' current recommendations for SLR cameras based on the unique needs of dental photography are as follows: camera bodies: Nikon—the D300S, the D7000, and D90s; Canon—the 7D, the 60D, the T3i. Though there are more expensive cameras available than these, the crop sensor on these models provides an ideal balance between resolution, noise, and depth of field. One of the main reasons for recommending these cameras is that they offer better white balance control than less expensive versions of SLR-type cameras. Another reason is that these Nikon or Canon models have flash systems that are ideally suited to dental macro photography.

MACRO LENS SELECTION

The lens required for most dental photography is a macro-specific lens (or micro for Nikon) of approximately 100-mm focal length with a maximum f/stop of approximately 2.8. Higher quality lenses generally include ease-of-use features such as image stabilization, fixed lens length, better image quality, and faster autofocus (when needed). Currently, there are seven lenses fitting the criteria needed for dental photography as listed in Table 1.

FLASH SELECTION AND SETUP

The camera component with the greatest effect on the quality of the final image is the flash setup. There are several styles, brands, and approaches to macro flashes. The authors have found dual-point flash systems (Figure 2) to yield the greatest image quality in a portable package. Dual-point flashes generally consist of two flash heads mounted to each side of the lens with an adjustable flash bracket. Alternatively, ring flash systems (Figure 3) consist of two flash heads in a ring-shaped diffuser body mounted to the end of the macro lens. Ring flashes are ideal for situations where ease of use (particularly for beginners) is a priority over maximum esthetics (ie, surgical and intra-operative images). More discerning dental photographers will find that strategic implementation of soft-boxes, diffusers, and polarizing films will give even greater control.

When using dual-point flashes there are several techniques that will further improve consistency and image quality. Through various experiments and trials, the authors have determined that the ideal flash position for imaging the anterior dentition is with the flash heads positioned approximately 3 inches lateral to and 2 inches posterior to the front lens element (Figure 4). In order to allow the requisite flexibility, an adjustable flash bracket is needed to maximize a dual-point flash system.

Advanced users may also find that attaching polarizing film (in parallel) over the flash units will reduce glare and provide a deeper and clearer appreciation of the characterization of the anterior dentition (Figure 5). Adding a polarizing filter over the front element of the lens will also allow the user to dial in or out the amount of specular reflection desired.

CAMERA SETTINGS

Though SLR cameras may initially seem to offer a vast array of settings, there is a strong case to be made for uniform settings in dental photography. The camera should be set to record as highest quality JPEGs for most images to allow for cropping, zooming, and printing. For shade images, or image requirements for admission to cosmetic or esthetic academies, as well as other critical images, the camera should be set to record images in RAW, which will allow the greatest flexibility in postprocessing and fine-tuning of exposure.

For intraoral images, the aperture should be set to f/32 (though f/22 to f/45 will suffice). For full-face images, the aperture should be set to f/8 (f/5.6 to f/11 will also suffice) to allow for sufficient exposure and depth of field. The exposure mode should be set to aperture priority (often denoted as Av). However, the manual exposure mode (M) is preferable with certain models of camera, and as a user develops expertise, it gives the photographer the greatest control. If using manual exposure mode, it is recommended to set the shutter speed to approximately 1/250 (setting the shutter speed as high as possible will also negate most of the ambient lighting).

The white balance is often a subject of debate. It should be made clear that this topic is of no consequence for users recording images exclusively as RAW (as the white balance will need to be set in

TABLE 1 // Camera Lenses Suitable for Dental Photography

FOR NIKON
Nikon AF-S VR Micro-Nikkor 105mm f/2.8G IF-ED
Nikon AF-S DX Micro-Nikkor 85mm f/3.5G ED VR
FOR CANON
Canon EF 100mm f2.8L USM IS Macro
Canon EF 100mm f2.8 USM Macro
AFTER-MARKET LENS AVAILABLE FOR NIKON OR CANON
Sigma 105mm f2.8 EX DG Macro
Tokina 100mm AT-X M100 Pro D f2.8 EX DG Macro
Tamron SP 90mm F/2.8 Macro

postprocessing). White balance settings on the camera control the color temperature of the JPEG image to ensure that the colors are accurately recorded. The effect of the white balance is most noticeable in dental photography when it is set incorrectly and the gingiva appears too yellow or too blue.

In order to avoid such inaccuracies, it is the authors' opinion that a custom white balance setting be used. This is done by taking a full-frame image of a photographic gray card with the flash setup to be used, and setting the camera's custom white balance to this image (this process is different for each camera; consult the user manual for specific instructions). For beginners, the white balance can alternatively be set to the "flash" white balance setting, which will generally give suitable results.

One of the primary advantages of an SLR camera is the ability to consistently record images at the same magnification setting because of the clear magnification markings on the body of the macro lens (point-and-shoot style cameras generally require zooming in and out in an attempt to maintain magnification). This is done by setting the magnification to predetermined points on the lens barrel (on crop-sensor cameras, these are 1:15 for full face, 1:3 for full mouth, and 1:1.5 for close-ups). In order to make use of this feature, the lens must be set to the manual focus setting and the user must resist the temptation to focus by turning the focus sleeve instead of moving into or away from the subject.

For advanced users with higher-end equipment, it is advantageous to utilize a hybrid focus mode whereby the autofocus trigger is programmed to an alternative button. The lens is set to the desired magnification, the subject is positioned in the frame as desired, the autofocus button is depressed, and immediately following confirmation of focus lock the shutter is fired. The hybrid focus allows great consistency with increased accuracy.

VIDEO

SLR cameras include video capture. Much of the initial diagnostic decision-making in complex esthetic cases involves recording the position of the teeth in relation to the face and lips. Generally, such images include the following views: lips in repose (M view), maximum reveal (E view), and fricative or A-P position (F view). The position of the teeth in relation to the lips is a dynamic relationship and is best recorded as such. A video record of the teeth and lips throughout these movements can provide a significant improvement in diagnostic accuracy.

Fig 6. A flash diffuser is a compact way to turn a standard hot-shoe flash into good portrait lighting.

Though the flash cannot be used for video (video light sources are available), the authors have found the ambient operatory lighting to be sufficient with the following settings: ISO 800, f/8, shutter speed 1/30 to 1/60, monochrome, magnification 1:3. Image stabilization (vibration reduction) is invaluable for video recording (use of a tripod is a viable alternative). The color temperature of the ambient operatory light is distracting in video captures and is best resolved through the use of a monochrome setting. Dentists and technicians alike will be significantly better equipped to make diagnostic decisions based on the video capture of the dynamic lip movements versus static image capture.

PORTRAIT IMAGES

On-camera flashes, including the dual-point and ring flash, give a harsh, unflattering illumination for a portrait. Softer lighting (ie, large and diffuse) is desirable for postoperative full faces and portraits. For professional-looking portraits and where space allows, a minimum of one studio strobe light will need to be set up with a soft-box and a reflector. For portraits using this setup, the strobe light should be positioned on one side of the subject and the reflector placed on the other to reflect light and give a more even illumination.

Another simple, cost-effective way to acquire high-quality portraits is by using a diffuser (eg, Lightsphere II Portrait Diffuser, Gary Fong, Inc., www.garyfongestore.com). The diffuser, which attaches to a standard on-camera flash as shown in Figure 6, bounces the light off of the walls and ceiling to provide a more flattering illumination.

IMAGE MANAGEMENT

Managing a vast number of images can be daunting. The authors have found two software programs ideal for this purpose: Adobe® Photoshop® Lightroom 3 and Apple Aperture®. These programs are very similar and allow users to customize image management to their liking. Both programs also provide the ability to efficiently categorize, sort, find, and clean-up images.

Additionally, many practice management software programs allow inserting and categorizing patient images, though typically their management and processing tools are basic when compared to these two programs.

WIRELESS IMAGE TRANSFER

One of the most useful and exciting developments in digital photography is the ability to wirelessly transfer images from the camera to a computer or iPad®, made possible by the Eye-Fi Pro X2 card (Eye-Fi, Inc., www.eye.fi). The card is a secure digital (SD) memory card and wireless router in one. The setup can be difficult and often requires IT assistance, but the results are efficient and impressive. Depending on the image size and type, images can be shown full-screen automatically on a computer or iPad within seconds of capture. The authors have found this to be highly useful during the patient examination process.

SUMMARY

Digital dental photography is an exceptional tool for communication, diagnosis, and documentation. So much of what is possible today with dental treatment hinges strongly upon dentists' ability to fully capture the necessary diagnostic information and properly educate their patients. With the proper training, techniques, equipment, and implementation, dental photography can significantly enhance the level of treatment provided.

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